
Franc Solina

15 sekund slave / 15 seconds of fame

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Med algoritmom in družbo - računalniška umetnost

Računalniška umetnost je pravzaprav šele na začetku svoje teoretične osmislitve in zato je seveda razumljivo, da je njeno mesto znotraj dvesto ali celo dvajset tisoč let stare umetniške institucije problem, ki potrebuje pojasnitev. Dandanes je nedvomno pomembnejši, in za nas zanimivejši, pojem umetnosti povezan z romantično uveljavitvijo umetniškosti v ožjem pomenu besede, torej kot produkta ustvarjalnosti novoveškega subjekta, od manj določenega pojma, ki pokriva pojave človeške kulture nasploh. Računalniška umetnost je z modernim pojmovanjem umetnosti v sporu že od svojih prvih refleksij, Vilém Flusser, denimo, piše, da je tehnična slika (tudi tehno-slika) rezultat sodelovanja dveh subjektnih pozicij, konstruktorja aparata, inženirja, in uporabnika, ki šele skupaj sestavljata institucijo sodobnega računalniškega umetnika. Projekta Franca Soline 15 sekund slave in Virtualno smučanje sta zavezana omenjenemu prelomu, saj povezujeta dve do sedaj nezdružljivi področji - znanost in umetnost -, ki ju bo, če želimo umetnost rešiti pred stagnacijo, nedvomno nujno potrebno združevati.

Povezovanje umetnosti in znanosti je problem, pravzaprav na prvi pogled jasen in nepremostljiv. Za Martina Heideggerja je bila tehnika zavezana racionalnemu uporabnostnemu obvladovanju sveta, ki sodi v diametralno nasprotni pol občutja in mišljenja kot za umetnost značilno pesniško mišljenje biti (ki se sicer prav tako razkriva skozi posebne vidike tehnike). Tehnika v tem pomenu sicer močno presega okvire pojma znanstvenosti, vendar pa ga nedvomno vključuje. Za filozofijo in umetnost je sporna, če smo natančni, znastvena epistemologija, ki je seveda problematična, vendar pa se tej problematičnosti, pravzaprav breztemeljnosti, računalniška umetnost ne more izogniti. Na drugi strani ostaja nagovor realnosti, ki je danes lahko nagovor narave in idilične neposredne medčloveške komunikacije le skozi namerno naivni pogled. Svet je posredovan, ne samo to, svet je tehnološko posredovan, in sicer v obeh pomenih besede, tako v širšem, kjer se tehnika navezuje na racionalno mišljenjsko obvladovanje sveta, še bolj pa skozi digitalne informacijske tehnologije, tehniko v najožjem pomenu besede. Umetnost se, če naj ostane relevantna družbena instanca, ne more zapirati pred to spremenjeno podobo realnosti ter z njo povezanim spremenjenim režimom delovanja tako v družbenem kot političnem polju. Umetnost se - v svoji digitalni različici - vključuje v sodobne pretoke informacij ter ob tem prisostvuje pri političnem preoblikovanju našega življenjskega prostora. Razlog za ta nujni prehod je, v jeziku filozofije, kriza subjekta.

Franc Solina je svoja projekta razvil znotraj institucije ArtNetLab, najprej neformalne skupine, kasneje pa formalno ustanovljenega društva, ki ad hoc združuje mlade strokovnjake s področja računalniških in informatiških znanosti ter strokovnjake s področja likovnih umetnosti. Kot profesor na Fakulteti za računalništvo in informatiko je skupaj s prof. Srečom Draganom z Akademije za likovno umetnost, oboje z Univerze v Ljubljani, nosilec strokovnega sodelovanja umetnosti in znanosti v Sloveniji na ravni univerzitetnih institucij. Projekta, zgolj dva med mnogimi, ki jih omenjena povezava omogoča in celo pogojuje, prodorno ilustrirata različne razsežnosti, ki se razkrijejo ob trku nezdružljivih pristopov, umetnosti in znanosti.

Leta 2002 prvič predstavljena interaktivna instalacija 15 sekund slave je sestavljena iz kamere in ploskega zaslona, ki kot slikarska slika uokvirjeno prikazuje vizijo kamere in programskega algoritma. S pomočjo tehnik računalniškega vida (projekt je nastal v Laboratoriju za računalniški vid Fakultete za računalništvo in informatiko) vstopa projekt v odnos z javnim prostorom okoli instalacije. Pri tem je po eni strani pomembno, da se skozi aluzijo na slikarstvo Andya Warhola podoba na kameri reintegrira v socialni in posebej v galerijski prostor, voden z nekoliko drugačnimi zakonitostmi umetniške institucije kot drugi segmenti realnosti, vendar pa se projekt po drugi strani na še zanimivejši način kaže kot poseg v režime ekonomije vidljivosti in prosojnosti, ki je v sodobni umetnosti pomemben tako v umetniških projektih povezanih z nadzornimi kamerami kot tudi, v širšem smislu, z mediji lociranja (locative media).

Ključno referenčno delo raziskovanja ekonomije vidljivosti je analiza Benthamovega Panopticona v knjigi Nadzorovanje in kaznovanje Michela Foucaulta. Sodobna disciplinarna družba temelji na režimih vidljivosti in klasificiranja, ti pa so skozi prečenje panoptičnega diagrama preželi tudi temelje humanističnih ter družbenih znanosti in ved. Vendar pa panoptizem ni zgolj drugo ime za zmuzljivi metafizični temelj, ampak dejanski skupek postopkov, ki se z njimi filozofija sama ne more soočiti. Posamezne institucije in tehnike upravljanja vidljivosti se povezujejo z drugimi tehnikami na povsem konkretne načine, ki jih ni smiselno zvajati na skupni imenovalec metalogike panoptizma. Projekt 15 sekund slave daje specifičen odgovor na vprašanja panoptičnih strojev danes. Če v popularni računalniški igrici Polživljenje 2 (Half Life 2, 2004) še razumejo nadzorne kamere kot leteče robote v obliki velikih očes, ki zgrabijo človeka in mu - predstavljati si je treba ogromno železno maso - čisto od blizu pogledajo v oči, pa Solinovih 15 sekund slave na v panoptičnem slogu prefinjen način skrije vso strojno opremo v programsko opremo, ki na pameten način vidi svoje subjekte ter jih presnavlja v "podložnike".

Humanisti nis(m)o preveč veseli, ko slišimo besedo "pameten" v zvezi s strojem. Pameten je seveda samo človek, kar je morda res, vendar pa to še ne pomeni, da ni vmesnih stopenj, ki sicer morda niso "pametne" v smislu hermenevtičnega odnosa do sogovorca, so pa nedvomno kompleksno sestavljene. Benthamov panoptizem je v svojem jedru skrival obrat: res je, da obstaja razgledni stolp, vendar pa je kot subjektna pozicija zgolj ena od mnogih, ki jo konkretno človeško telo zaseda, to pomeni, da se opazovalci in opazovani izmenjujejo. Še več, na mestu pogleda lahko sploh nikogar ni, važna je zavest o gledanosti, ki gledalca virtualizira ter ga izrazi v obliki socializacije gledanega. Človek je "vdružbljen" skozi stalno zavest o videnosti. V instalaciji 15 sekund slave je mesto gledalca razervirano za računalnik, to pa ne pomeni, da je povsem prazno. Sistematizirajoča vnema znanstvene humanistike, ki jo analizira Foucault, se ukvarja s prepoznavanjem značilnih shem, ki naj uredijo svet za večjo produktivnost, računalniški algoritem pa v našem primeru instalacije dela ravno to, sam prepoznava pomenonosne segmente dogajanja pred kamero ter jih shranjuje v podatkovno bazo, ki jo kasneje seveda lahko prebrskamo in s pomočjo računalnika z zelo veliko hitrostjo najdemo relevantne podatke.

Kamera namreč posname zelo širok vidni kot dogajanja pred objektivom, nato pa algoritmi računalniškega vida poiščejo vse portrete, ki so na vsakokratnem posnetku. Pri tem je zelo važno, da instalacija izbira svoje izhodne podatke na način t.i. montaže iz podatkovne zbirke, osrednjega postopka jezika digitalnih medijev, kot ga opisuje Lev Manovich. Če se nekdo skuša skriti pred pogledom instalacije, se, kot lahko zagotovim, pravzaprav ne more. Na zaslonu se namreč ne pokaže nujno oseba, ki je na sredini posnetka, ampak naključno izbran portret iz podatkovne zbirke. Pri tem nastaja napetost, gledalec, pravzaprav pasivni uporabnik instalacije, je ujet v panoptizem stroja vseskozi, ko je navzoč v prostoru, kjer je instalacija (in zakaj ne bi kak obsedeni kontrolor, zbiralec portretov, postavil cenenih kamer v vse prostore?). V podatkovno zbirko se potencialno vnašajo tudi tisti, ki niso petnajst sekund slavni, ki jih ekran torej ne prikaže. Če povzamem, da ne bo nesporazumov, pametnost je v tem primeru pametnost računalniškega prevajanja panoramske slike prostora v podatkovno zbirko portretov - nič več in nič manj.

Instalacija pa uporablja metodo montaže iz podatkovne zbirke še na en za sodobne novomedijske projekte značilen način. Izbrane portrete analizira in jih preoblikuje skozi nabor računalniških filtrov, ta pa je prav tako vnaprej programiran kot podatkovna zbirka, ki jo računalniški algoritem uporablja po vzorcu naključja. S tem je tematiziran tudi problem računalniške grafike in mesta avtorja v njeni produkciji. Če je bila izbira obarvanja reprodukcij zvezdniških portretov pri Andyju Warholu videti igrivo naključna, pa Solinov projekt nastaja na digitalni ravni informacijskih pikslov, ki jih podatkovna zbirka barvnih transformacij v celoti manipulira.

Tudi drugi projekt, Virtualno smučanje, temelji na postopkih računalniškega vida, ki postaja eno glavnih področij sodobne računalniške umetnosti. Gre za nov projekt, ki tematizira prepoznavanje slik na ravni interakcije človek - računalnik (human-computer interaction), področju načrtovanja vmesnikov za komunikacijo med človeškim jezikom in algoritmi računalnika. Uporabnik lahko z gibi svojega telesa krmari skozi virtualno pokrajino, računalniški vid pa tako zamenja klasični grafični uporabniški vmesnik (graphical user interface). Drugi vidik projekta se odpira v smer vstopanja človeškega telesa v digitalno tridimenzionalno generirano realnost v realnem času.

Perspektive za rabo računalniškega vida in načrtovanja vmesnikov za posredovanje med človekom in računalnikom pa se ne odpirajo samo v umetnosti. Interakcija človek - računalnik je najbrž eno najpomembnejših področij raziskovanja, ki se bo nujno moralo razvijati na interdisciplinarni ravni, saj npr. današnji trendi oblikovanja komunikacije z računalnikom poudarjajo predvsem na človeka in njegovo družbenost usmerjene načine razvijanja vmesnikov. Umetnost bi na tem področju lahko imela eno vodilnih vlog pri preverjanju obstoječih tehnik rabe računalnika v ekstremnih okoliščinah in pri uporabi tehnik na načine, ki bi jih lahko označili kot ekscesne, seveda ekscesne izključno na ravni rabe in zlorabe možnosti, ki jih tehnologija ponuja in včasih skriva.

mag. Aleš Vaupotič

Between Algorithm and Society - Computer Art

The place of computer art in the context of artistic traditions dating back two hundred or even twenty thousand years is still uncertain and the recent theory of computer art is to provide us with some answers. The concept of art that was developed in the romantic period - the art as a product of the creative subject - is in this case more important than the wider term that covers all manifestations of human culture. However, the computer art is in conflict with the idea of modern art already since its first theoretical reflections, e.g. Vilém Flusser writes that the techno-image is founded in the collaboration between two subject positions, the constructor of the machine and the user, whereby only together these two comprise the institution of contemporary computer artist. The projects 15 Seconds of Fame and Virtual Skiing by Franc Solina are fundamentally linked to this break, because they connect two till now non-connectable fields - science and art - which will have to be connected in order to revive the art today.

Connecting of art and science is seemingly a transparent problem that couldn't be solved. Martin Heidegger considers technology a part of rational and utilitarian governing of the world that is the opposite from the revelation of truth of being through poetic thought (which however is also related to certain aspects of technology). The technology in this case transcends the margins of the scientific, but still it includes it. What is questionable from the point of view of art and philosophy is the scientific epistemology that is clearly a problem; nevertheless in computer art this unfoundedness cannot be avoided. On the other hand, the transparent idyllic image of human communication is nothing more than an intentional naivety; today the reality speaks in a mediated form, not only that, it speaks in a technologically mediated one. Both meanings of the word are implied: technology as rational managing of reality and, even more importantly, digital information technologies, the technology in the narrowest meaning of the word. For the art to maintain its relevant social status it has to face these changes that are not critical only for the image of reality it conveys, but also for the way how the art functions in social and political field. The digital art is involved with contemporary flows of information that politically restructure our living space. The philosophical cause for this shift is the shattering of the subject.

Franc Solina developed his projects within ArtNetLab, in the beginning a non-formal group, which grew into a formally founded society, that ad hoc connects young specialists from the field of computer and information sciences and their peers from the fine arts. As a professor at the Faculty of Computer and Information Science he is, together with Prof Srečo Dragan from the Academy of Fine Art, both University of Ljubljana, the promoter of expert collaboration of artists and scientists on the level of university. The aforementioned projects, just two among many that depend on this kind of interdisciplinary connection, are fine examples of different effects that come to life when two distinct approaches collide, the artistic one and the scientific one.

The interactive installation 15 Seconds of Fame was first exhibited in 2002. It consists of a digital camera and a flat computer screen with a frame that shows us the image produced by the camera and a software algorithm. The technologies of computer vision (the project was realised within the Computer Vision Laboratory, Faculty of Computer and Information Science) integrate the project into its surrounding social context. The Andy Warhol reference relates the image to the art gallery institution that functions differently form the non-artistic sphere, however even more interesting it is how the project renegotiates the economy of visibility and transparency - being prominent today not only in projects with surveillance cameras but also in the projects connected with the locative media.

The most influential work on economy of visibility is Discipline and Punish by Michel Foucault that analyses the Jeremy Bentham's Panopticon. The modern disciplinary society is founded in the protocols of visibility and classification that define the panoptical diagram traversing also the core of social sciences and humanities. We should note that panopticism isn't just another name for the ever-elusive metaphysical foothold; it is a series of actual procedures, which are beyond the grasp of philosophy. Particular institutions and technologies of visibility are linked to other technologies in singular ways that are made irrelevant if we construe them simply as phenomena of panoptic meta-logic. Solina's project 15 Seconds of Fame gives us a concrete answer to the question of the panoptic machine today. If the popular computer videogame Half Life 2 (2004) still pictures surveillance cameras as huge flying robots in the shape of eyeballs that dock onto a person's head and scan his face or retina, then the panoptic elegance of the 15 Seconds of Fame becomes apparent; most of the hardware is hidden in the software that smartly sees its subjects.

The humanities' scholars are ill at ease when we hear the word "smart" in connection to a machine. Only the human is smart, which may be true, but nevertheless it doesn't mean that there are no different levels; machines may not be intelligent in a hermeneutical meaning of the word, still they are complexly composed. Bentham's panopticism of course hides a twist: there is the watchtower, but as a subject position it is only one among many that a particular human body embodies, i.e. the watchers and the watched interchange. Moreover, the post in the tower could be empty, still what matters is the knowledge that one is watched, the watcher is thereby virtualised and represented in the socialisation of the watched. The human is introduced to society through the constant sense of visibility. In the installation 15 Seconds of Fame the computer occupies the position of the watcher, but this doesn't mean that it is empty. The constant striving for systematic knowledge of the humanities, analysed by Foucault, works with scheme detection in order to discipline the world for greater productivity. In our case the computer algorithm does exactly this, it recognizes the meaningful segments of action going on in front of the camera and collects them in a database - that can be later very efficiently browsed by means of a computer to get the relevant data.

The camera in the installation actually records a very wide angle of space in front of it and immediately the algorithms of computer vision search for all the portraits that can be found on the image just taken. It is crucial that the data presented on the screen of the installation is determined by means of the montage from the database, i.e. the main technique of the language of digital media as described by Lev Manovich. If somebody would try to hide from the installation's gaze, I can assure, that he/she couldn't. On the screen one can see out of the database randomly selected portrait and not the person in the centre. A tension is created, who will be on the next image. The actually passive-interactive participant is captured by the panopticism of the machine as long as he is in the room with the installation (and why wouldn't an obsessed controller place inexpensive cameras in all the spaces?). The database therefore potentially includes also the gallery visitors that aren't famous for fifteen seconds. To summarize, to avoid misunderstandings, the intelligence of the machine is the smart computerized translation of a panoramic image of the space into a database of portraits - not more nor less.

However, the installation addresses the concept of montage from database yet in another typical way. The portraits are analysed and transformed by means of assorted computer filters that are pre-programmed and collected into a database of algorithms for picture manipulation from which the algorithm chooses and applies them randomly. This reflects also the problem of computer graphics and the role of the author in its production. While the selection of colours in the coloured reproductions of Andy Warhol's portraits appears to be playfully coincidental, the project of Solina takes place not on the level of image but on the level of mere pixels, of digital information points that are being completely manipulated by the selection of colour filters.

The project Virtual Skiing is based on the computer vision principles, too, as the field of research in computer vision technology is becoming one of the most prominent fields of interest in computer arts. Virtual Skiing is a new project that accounts on the image recognition algorithms on the level of the human-computer interaction, i.e. the level of interface design that mediates between the human language and the computer algorithms. The user can navigate through the virtual landscape by means of his/her bodily movements, whereby computer vision replaces the classical graphical user interface. The second aspect of the project reflects on the entering of human body into the digitally generated three-dimensional reality in real time.

However, the perspectives for the employment of computer vision and the human-computer interface design are not limited to its use in art. Human-computer interaction is one of the most important scientific research fields that has to open up also on an interdisciplinary level, even more so since the contemporary trends in communication design stress the importance of human oriented and socially applicable interface developments. Artistic use could be the measure for the possible extreme use of computer technology; i.e. use in extreme circumstances and in excessive ways of employing the existing techniques, excessive exclusively on the level of use and misuse of the possibilities that are being offered and sometimes also hidden by the technology.

Aleš Vaupotič, MA

ACM Multimedia, New York, NY USA, 13. 10. 2004

CrossOver, Klagenfurt/Celovec, 28. 9. - 23. 10. 2004

9. slovenski festival znanosti/9th Slovene Science Festival,
Narodna galerija/National Gallery, Ljubljana,
14., 16. 10. 2003

Friendly Fire, Forum Stadtpark, Graz, 19. - 26. 9. 2003

LEK's New Year party, Cankarjev dom, Ljubljana, 11. 12. 2002

InterINFOS 2002,
Cankarjev dom, Ljubljana,
21. - 25. 10. 2002

Finžgarjeva galerija/Finzgar gallery, Ljubljana, 14 . - 26. 11. 2002

8. MFRU/8th International festival of computer arts, Maribor,
28. 5. - 1. 6. 2002

COLOR-BASED FACE DETECTION

Paper by: Franc Solina, Peter Peer, Borut Batagelj, Samo Juvan, Jure Kovač

1. INTRODUCTION

Technology influenced artistic production throughout history. In the later part of the 20th century the fast advent of computer and information technology in particular left a strong impression in the art world [5, 22]. The installation "15 seconds of fame" was inspired by Andy Warhol's celebrated statement that "In the future everybody will be famous for 15 minutes"[21] and his photography derived paintings of famous people. Warhol took faces and persons from mass media, banal in their newspaper everydayness, and transformed them into paintings by performing some kind of color surgery on them. By separating the face from the background or selecting distinct facial features (i.e. mouths, eyes, hair) he obtained image areas which he highlighted or covered with paint. Warhol portrayed in this fashion celebrities from arts and politics (i.e. Mao-Tse Toung, Marilyn Monroe, Jackie Kennedy, etc.). Some of these images are true icons of the 20th century [7].

The installation "15 seconds of fame" intends to make instant celebrities out of common people by putting their portraits on the museum wall. Instead of providing 15 minutes of fame as prophesied by Warhol we decided to shorten this time to 15 seconds to make the installation more dynamic. This period also limits the time necessary for computer processing of each picture. Since the individual portraits, which are presented by the installation, are selected by chance out of many faces of people who are standing in front of the installation in that moment, the installation tries to convey that fame tends to be not only short-lived, but also random. However, people can prolong their fame by ordering their portrait over the Internet, printing it on paper, framing it and putting it on the wall.

1.1. How the installation works

The visible part of the "15 seconds of fame" installation consists of a LCD computer monitor which is framed like a precious picture and hangs on the wall. The digital camera is hidden behind the frame above the computer monitor so that only a round opening for the lens is visible. Pictures of gallery visitors which are standing in front of the installation are taken by the digital camera using a wide-angle lens setting (Fig. 1a). The camera is connected with the hidden computer via USB connection, so that the camera can be remotely controlled by the computer. Each digital photo is analysed by the computer to detect faces in it (Fig. 1b, c, and d show steps in the face detection). The software then randomly selects one of the faces and crops it from the larger picture. This processing performs the same function as a photographer who would take from that viewpoint a portrait of one of the visitors using a telephoto lens.

The selected portrait is then transformed using randomly selected color filters to automatically generate a Warhol inspired pop-art portrait. The resulting portrait is then displayed for 15 seconds on the picture/monitor together with a unique ID number. In the mean time, the processing of the next portrait is taking place, so that after fifteen seconds another pop-art portrait can be displayed. In this fashion every fifteen seconds a new picture is taken, a new portrait selected and processed, so that it can be displayed in the next 15 second period.

If several people are standing in front of the installation the software tries to select each time a different person. Even if just a single person is present in front of the installation, the randomly selected graphic effects assure that the displayed portraits are never the same. If the system does not detect any face, the last detected face is being displayed, but with a different graphic effect in each 15 seconds period. Since portraits displayed by the installation are saved in a database, they can be ordered by sending e-mail to 15sec@lrv.fri.unilj.si with the corresponding portrait ID number in the subject field.

2. FINDING FACES IN COLOR IMAGES

Automatic face detection is like most other automatic object-detection methods difficult, especially if sample variations are significant. Large sample variations in face detection arise due to a large variety of individual face appearances and due to differences in illumination.

There are a few distinct approaches to face detection (for a detailed survey see [13]). We decided to use in the installation a color-based approach of face detection that we developed earlier [17]. In the next Subsection 2.1 we describe our original method while in Subsection 2.2 we reveal the simplifications of this method that we had to make for the installation.

2.1. Our original face detection method

We developed a face detection method which consists of two distinct parts: making of face hypotheses and verification of these face hypotheses [17]. This method combines two approaches: color-based and feature-based approach.

The basic idea of the method is as follows: find in the image all skin-like regions, which contain possible candidates for an eye, then on the basis of geometric face characteristics try to join two eye candidates into an eye pair and, finally, confirm or refuse the face candidate using skin color information. The main steps of the method described in [17] is illustrated in Fig. 2. The skin color of fair complexion under uniform daylight illumination is determined with the following rules [15, 17] which describe the skin cluster in the RGB color space

$$R > 95 \ \& \ G > 40 \ \& \ B > 20 \ \& \\ \max\{R, G, B\} - \min\{R, G, B\} > 15 \ \& \\ |R - G| > 15 \ \& \ R > G \ \& \ R > B.$$

We tested also other color models [15] but the best results were obtained with this one.

The goal of the method was to reach maximum classification accuracy over the learning and testing sets of images under the following constraints: near real-time operation on a standard personal computer, plain background, uniform ambient natural or studio illumination, faces of fair complexion, which must be entirely present in the image, and faces turned away from the frontal view for at most 30 degrees.

During the processing the method requires some thresholds, which are set quite tolerantly, but they become effective in a sequence. All thresholds were defined experimentally. The method was developed using different training sets of pictures [3] and tested over an independent testing set of two public image-databases [16, 18] with good results [17].

Since the original face detection algorithm is computationally demanding, we decided to develop a simpler version for integration in the "15 seconds of fame" installation.

2.2. The simplified face detection method

In order to confirm a given face candidate in our installation, we modified the original face detection method as follows. When the color picture is downloaded from the digital camera (we normally use resolution 2048×1536 pixels) to the computer, the system reads the picture and first decreases the resolution in a pyramid manner down to 160×120 pixels. The system searches for face candidates in the lower resolution to speed up the process, but the selected face is later cropped from the original resolution for final processing. The system then eliminates from the picture all pixels that do not correspond to skin color. After this color segmentation the system applies a region growth algorithm, which segments all face-like pixels into candidate face regions.

Each candidate face region must pass some simple tests to qualify as a true face region. Since the confirmation of hypothesis in the simplified method relies entirely on simple heuristic tests and not on structural information (i.e. eye pairs), we had to make them more stringent. Initially, for example, we had problems with bare arms which the system recognized as faces. The face candidate region must be large enough (based on the assumption about the minimal size of the face in the original picture), have rough face proportions (width/height ratio of the rectangular box containing the candidate face region), and have a high enough percentage of skin pixels within this box. The results are much better, although still not perfect. However, this is not too annoying-now and then it still happens that someone's arm or palm becomes famous for 15 seconds. The side benefit of the simplified method is that faces seen from the profile can also be detected.

The final step of finding a face for the portrait is selecting one of the faces (randomly, but with help of some heuristics, like giving bigger priority to bigger regions and regions that are higher in the picture), mapping the face coordinates from the lower resolution picture to the original resolution picture and cropping the face out of the original picture. Fig. 1 illustrates the described process. The selected portrait is cropped from the original digital image as a square area and resized to the resolution of 400×400 pixels.

The databases that we used for developing and testing of our original face detection method contained pictures taken in daylight or under white-balanced studio illumination. When the performance of the face detection algorithm during the first public exhibition was not fully satisfactory, it was mainly due to difficult illumination conditions. Once we realized that we will not be able to completely control the illumination in different exhibition spaces, we decided to improve our face detection results by eliminating the influence of non-standard illumination.

3. ELIMINATING THE INFLUENCE OF NON-STANDARD ILLUMINATION

The purpose of studying methods for eliminating the influence of non-standard illumination in our project is to improve the results of our face detection algorithm. Nonstandard illumination conditions are by definition those that are more or less different from daylight illumination (CIE standard D65) [23]. We find such illumination almost anywhere in enclosed spaces with artificial illumination, where the installation could potentially be exhibited. There are two main groups of methods for addressing this problem: color compensation methods and color constancy methods.

3.1. Color compensation methods

Methods in this group have low time complexity (order of $O(n^2)$) and they do not need a preliminary learning step. This means that they are easy and straightforward to implement. Their effectiveness is relatively high on sets of images with some input constraints. Illumination should be relatively close to standard illumination. The input image is transformed in the way that the colors in the image are leveled in respect to some statistical quantity.

Grey World (GW) [11] algorithm presents simple and fast method for color compensation on images which are defined in RGB color space [10]. It is based on the presumption that the average surface color on the image is achromatic. This means that the average color, which is reflected from the surfaces, corresponds to the color of the illumination. To execute the algorithm we have to calculate the averages for each channel R, G and B for the whole image. Averages are then transformed with the help of a linear scale factor to values that correspond to the mean grey value of one standard illuminant.

Modified Grey World [9] method is very similar to basic GW algorithm with the difference that the scale factors are calculated in a slightly different way. The average of each channel is calculated by counting each color only once, regardless of how many times the color appears in the image. By doing so, we eliminate the influence of colors represented by a large number of pixels in the image on the average color. The method is effective on images, which do not contain a lot of different colors.

White-Patch Retinex [11] method is like the Modified GW method just a special version of the basic GW method. The difference lies again in the method of calculating the scaling factors. Instead of the average color we use the maximal value of each channel in the whole image. The Retinex method is above all suitable for dark images.

3.2. Color constancy methods

Methods belonging to this group differ from the color compensation methods above all in the need to integrate a preliminary learning step. They require the knowledge about illumination properties and properties of the capturing devices, e.g. digital cameras. The input image is then transformed in such a way that it reflects the state, which is independent of the illumination. Thus a stable presentation of colors under different illuminations is achieved. Generally speaking the methods consist of two distinct steps: scene illumination detection and standard illumination reconstruction. In the first step, the algorithm determines with the help of preliminary knowledge which illumination out of the set of known illuminations is present in the image. In the second step, it applies the necessary transformations to reconstruct the standard (or other wanted) illumination.

In the Color by Correlation method [9] the preliminary knowledge about the illumination properties is represented with a set of colors, which can appear under specific illumination, i.e. colors that are visible under specific illuminant.

After the illumination detection based on correlation technique takes place, we need to reconstruct the image scene under some standard illumination conditions. To perform such reconstruction, certain transformations should be applied. To calculate the transformation parameters, we need the information about the spectral power distribution. We can gain this information with the help of the Macbeth color checker[8]. We need two images of the Macbeth color checker captured under different illuminations. The first one should be captured under the same illumination as the input image, which we want to reconstruct. The second image should be captured under standard (or other wanted) illumination, which we want to use in the reconstruction process.

3.3. Comparison of methods

3.3.1. Color compensation methods

In order to determine the influence of these algorithms on our face detection results, some experiments were performed on the set of images gathered in our lab and at the first public showing of the installation. The testing set is composed of 160 images taken under four different types of illumination conditions. One subset of images (40 images) was taken under standard daylight, in the second subset (40 images) objects were illuminated by incandescent lamps assembled into a chandelier, the third subset (40 images) was taken under camera flash light conditions, and the last subset of images (40 images) was taken under neon light illumination conditions. After that, one of the color compensation methods was applied and finally, face detection algorithm was applied to original and preprocessed images.

Results gathered in Tab. 1 show perceivable improvement in face detection on images taken under different than standard illumination conditions when one of the compensation algorithms was previously applied (see Figs. 3 and 4). GreyWorld algorithm performed especially well since for the flashlight, incandescent and neon light conditions a considerable increase in TP/Det percentage can be noticed.

All these results are dependent on our skin detection technique used for face detection, which works in the 3D color space (RGB). Some research suggests that skin detection in 2D color space (YUV) might be better since it is less brightness dependent than detection in the 3D color space (RGB) [10]. Our experiments on the data collected with this installation, however, do not prove the advantage of the 2D color space [15].

The results also show that the performance of these techniques depends very much on the type of the illumination. Therefore a considerable amount of precaution should be taken in decisions about the usage of these techniques. On the other hand all of these algorithms are very effective from the time complexity point of view and as such they enable the possibility of performing a simple initialisation test when the scene is first placed under certain illumination. In this way we can determine which algorithm would produce the best results under certain type of illumination.

3.3.2. Color constancy methods

Tests for the correlation method were performed in order to determine the best merit (function) for illumination detection. The testing set contained 156 images with none, one or multiple faces, taken under 5 various illumination conditions. The white subset represents the standard illumination conditions, while red, blue, green and yellow subsets were generated by illuminating the scene with the corresponding color light.

First, illumination detection on images was performed with a correlation technique, then the images were reconstructed under approximation of standard illumination and finally face detection algorithm was applied on images (Figs. 5 and 6). Results are summarized in Tab. 2. Results of subset white are shown as a comparable reference to other results. Columns with no method previously applied (None) can contain zero detections. This can occur if face detection algorithm finds no skin color in an image, which can often be the case in extreme illumination conditions.

Results in Tab. 2 show the positive effect of color correction on images with non-standard illumination conditions. If we do not apply preprocessing, the face detector finds some faces only on images from the yellow subset. After the preprocessing step almost all faces were recovered under this illumination, while under all other illuminations the number of recovered faces was not that high, but the difference with the results gained without preprocessing is enormous. In the blue subset we see a very large number of false detections caused by the mixture of incandescent and blue light. This mixture was necessary for enhancement of other than blue color channels (R and G) since blue filter was very strong. If only blue channel is present, we have as much information as in achromatic pictures. Incandescent light caused an interesting effect of making all shadows in reconstructed pictures slightly yellow and as a consequence many false faces were found. Nevertheless, with the exception of blue illumination these results are quite comparable with the results in Section 3.3.1, where face detection was tested under close to standard illumination conditions.

3.4. Method selection

The nature of illumination in some galleries can represent a real problem since it normally differs from daylight illumination. In older rooms in particular we usually have chandeliers or similar types of illumination that emit a prevailing yellow light into the room and as a consequence a prevailing yellow color in captured images. This causes the shift of a large part of image color space into the color subspace, which represents skin color. An illustrative example of this property can be observed on the white walls of a room. Normally they are white, but under incandescent lamp illumination they are more bright yellow than white. And since walls can occupy large parts of an image, it can happen that most of the image pixels are recognized as skin-like pixels (see Figs.3 and 5). This type of illumination can have a serious negative influence on the number of false face detections (false positives). In case of incandescent lamp illumination we should choose among color compensation methods described in Section 3.1. Based on the results of these algorithms and constraints discussed in Section 3.3.1, we decided to use GW algorithm as it performs best when minor lighting deviations from standard illumination are present. Although, some form of automatic selection is taken into future consideration.

A totally different story can be observed in discotheques, where illumination emits color light (e.g. blue, green, red etc.) into the room. This shifts all scene colors towards the color of the illumination. Consequently, a lot of skin-like pixels are recognized as non-skin-like pixels and the number of correctly detected faces (true positives) is decreased, since we can not reliably find skin-like pixels. When deviations from standard illumination are much more noticeable, we must choose a correlation technique with a proper illumination reconstruction. When illumination conditions are constant over a large period of time, no illumination detection is necessary. By manually selecting the illumination we eliminate all the risks linked with false illumination detection and assure the best illumination reconstruction.

Eliminating the influence of non-standard illumination before face detection ensures much better results. The whole system is much more flexible and the installation can be exhibited almost anywhere.

4. POP-ART COLOR TRANSFORMATIONS

As mentioned in the introduction, Andy Warhol took photographs of people and performed some kind of color surgery on them. In this process Warhol sometimes segmented the face from the background, delineated the contours, highlighted some facial features (the mouth or the eyes), started the process with the negative instead of the positive photography, overlayed the photo with geometric color screens etc. [7]. His techniques of transforming a photography into a painting could be described with a set of formal construction rules, like the ones used in shape grammars [12, 14]. The application of such rules for generation of new pop-art portraits which our installation tries to perform would require automatic segmentation of input images into its constituent perceptual parts: face/background, eyes, mouth, hair etc. These tasks are still too complex to be routinely solved in a few seconds on a large variety of input images. We decided therefore to try to achieve somewhat similar effects with much simpler means. Our system does not search for any features in the face but just processes the input image with selected filters.

We selected filters that achieve effects similar to segmentation. They drastically reduce the number of colors by joining similar looking pixels into uniform looking regions. The system randomly selects one out of 34 predetermined filter combinations and applies it to the portrait. 17 filters consist of different combinations of three well known filters: posterize, color balance and hue-saturation balance. The other half of filters are actually based on the first 17 filters, but with an important additional property, which we call random coloring. Random coloring works in the following way: the system selects a pixel from the already filtered image and then finds all other pixels in the image of the same color. Then the system randomly selects a new color from the RGB color space for these pixels. In this way, we achieve millions of different coloring effects and our pop-art portraits almost never look completely the same.

5. DISPLAY OF PORTRAITS

The installation displays on the framed monitor the selected portraits in 15 second intervals. For the display of the final result the system also selects randomly among five possible configurations: in 75% of cases it shows just a single processed portrait, in 25% of cases it subdivides the square display area into four smaller squares each showing a smaller version of the portrait. Each of the four smaller portraits can be processed with a different filter and the right-hand portrait column can be mirrored along the vertical axis. This way of stacking together multiple images also resembles Andy Warhol's way of displaying and amassing of images.

Since gallery visitors often stay in front of this installation for a longer period of time, we integrated a rule that prevents the selection of the same face, or a face at the nearly same location, in two subsequent 15 second intervals.

In the lower left corner of the LCD display is a counter counting the seconds from 15 to 0, reminding the currently "famous" visitor that his fame is fading away.

6. E-MAIL ORDERING OF PORTRAITS

When the installation was exhibited publicly for the first time almost everybody who was featured by the installation wanted to get a copy of his or her pop-art portrait. Since we were already storing all images in a database for later experiments in face detection, we decided to make the finished portraits available to the public.

Therefore, we display now along each portrait a unique ID number in the lower right corner. A visitor who would like to get his portrait must note this ID number and send it in the subject field of an e-mail message addressed to 15sec@lrv.fri.uni-lj.si up to one month after the end of the exhibition. The system periodically checks the e-mail messages, finds the requested portraits in the database and e-mails them as an attachment back to the sender of the request. In addition, a temporary web page valid for three days is generated, showing the requested portrait. On this page one can randomly change the pop-art effects and save the new versions. If during an exhibition the installation is not connected to the Internet online, the portraits are sent later. From all requested portraits a special web gallery of "famous" people is automatically built for each public exhibition on the project's web page [1].

7. CONCLUSIONS

The use of computer vision methods in art projects is stimulating and somewhat specific. The concept of the installation "15 seconds of fame" requires from the vision system to find at least one face in the image which is then in turn transformed into a pop-art portrait. Therefore a high percentage of true positive face detections is very important, so that the installation does not display too often other body parts or objects. False negative face detections are on the other hand not a problem if at least one face out of many is found in each input image, since only one face is selected randomly anyway.

Making the installation robust and easy to install and administer was also a challenge. In this paper we described in detail how the problem of non-standard illumination was solved so that the installation can be exhibited under a large variety of illuminations. Since the installation will hopefully be exhibited at several art festivals in the near future, it was also important to make the whole system easy to administer remotely over the Internet, so that the presence of the authors is not required during the whole exhibition period.

As a side product of the installation a huge database for experimentation with face detection has been assembled. This database which shows mainly groups of people (i.e. Figs. 1a, 3 and 4) is available on the Internet along with our older CVL face database [3].

The installation "15 seconds of fame" was well received by the public. Even people without any prior information on how the installation works quickly realized that the installation displays portraits of people who are present at the moment. But getting a share of that "fame" proved to be more elusive. People who would step right in front of the installation, trying somehow to force the system to select them for the next 15 second period of fame, would be more often disappointed seeing that somebody else way back or on the side was selected instead. The only strategy that worked was to stay in front of the installation long enough.

There are also several possible improvements on the conceptual side of this art installation. We could try, for example, to determine the facial expression of each selected face to classify it as happy, angry or sad [6] and choose for the pop-art portrait a range of colors that matches that mood. A completely new version of the installation entitled "secret thoughts", which is under development, will paste the texture of the selected face on an animated 3D face model and make the face speak out controversial messages.

8. REFERENCES

[1] 15 seconds of fame: http://black.fri.unilj.si/15sec [2] Art Net Lab: http://black.fri.uni-lj.si [3] CVL face database: http://www.lrv.fri.unilj.si/database.html [4] S. Dragan, F. Solina. New information technologies in fine arts. In F. Solina and S. Dragan, editors, Proc. Conf. New Information Technologies in Fine Arts, Fourth Int. Multi-Conf. Information Society - IS2001, pp. 441-444, Ljubljana, 2001. [5] T. Druckrey, Ed. Ars Electronica: Facing the Future. MIT Press, Cambridge MA, 2002. [6] I. Essa, A. Pentland. Coding, analysis, interpretation and recognition of facial expressions. IEEE Trans. Pattern Analysis and Machine Intelligence, 19(7):757-763, 1997. [7] F. Feldman (Editor), J. Schellman, C. Defendi, J. Schellman (Contributor), A.Warhol. Andy Warhol Prints: A Catalogue Raisonne 1962-1987. Distributed Art Publishers, 3rd Rev edition, October 1997. [8] G. D. Finlayson. Color Constancy in Diagonal Cromathicity Space, Proceedings of the 5th International Conference on Computer Vision (ICCV'95), pp. 218-223, 1995. [9] G. D. Finlayson, S. D. Hordley, P. M. Hubel. Color by Correlation: A Simple, Unifying Framework for Color Constancy, IEEE Transactions on Pattern Analysis and Machine Intelligence, 23(11):1209-1221, 2001. [10] A. Ford, A. Roberts. Colour Space Conversions, 1998, http://www.inforamp.net/˜poynton/PDFs/coloureq.pdf [11] B. Funt, K. Bernard, L. Martin. Is Machine Colour Constancy Good Enough, Proceedings of the 5th European Conference on Computer Vision (ECCV'98), pp. 445-459, 1998. [12] J. Gros, F. Solina. Describing artworks using shape grammars. Electrotechnical Review, 59(5):314-320, 1992. [13] E. Hjelmas, B. K. Low. Face detection: A survey. Computer Vision and Image Understanding, 83:236-274, 2001. [14] J. L. Kirsch, R. A. Kirsch. A rule system for analysis in the visual arts, Leonardo, 21(4):445-452, 1988. [15] J. Kovač, P. Peer, F. Solina. 2D versus 3D color space face detection. Technical report, Computer Vision Laboratory, Faculty of Computer and Information Science, University of Ljubljana, 2003. http://eprints.fri.uni-lj.si [16] M2VTS Face Database: http://www.tele.ucl.ac.be/M2VTS/ [17] P. Peer, F. Solina. An Automatic Human Face Detection Method, Proceedings of Computer Vision Winter Workshop, Ed. N. Br¨andle, pp. 122-130, Rastenfeld, Austria, 1999. [18] PICS Image Database: http://pics.psych.stir.ac.uk/ [19] F. Solina, Internet based art installations. Informatica, 24(4):459-466, 2000. [20] J. C. Terrillon, M. N. Shirazi, H. Fukamachi, S. Akamatsu. Comparative Performance of Different Skin Chrominance Models and Chrominance Spaces for the Automatic Detection of Human Faces in Color Images, Proceedings of 4th IEEE International Conference on Automatic Face and Gesture Recognition, pp. 54-61, 2000. [21] Andy Warhol (quoted in The Washington Post, 15 Nov 1979) in James B. Simpson, Simpson's Contemporary Quotations, 1988. [22] S. Wilson, Information Arts. Intersections of Art, Science, and Technology. MIT Press, Cambridge MA, 2001. [23] Joint ISO/CIE Standard ISO 10526:1999/CIE S005/E-1998 CIE Standard Illuminants for Colorimetry, 1999, http://www.cie.co.at/cie/

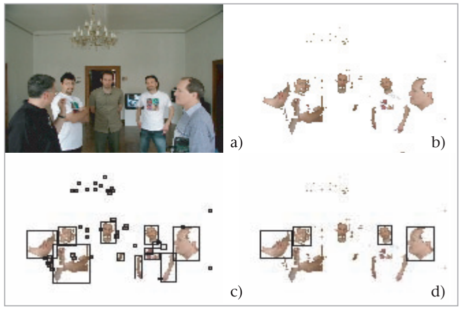


Figure 1: Stages in the process of finding faces in an image: a) downsize the resolution 2048×1536 of the original image to 160×120 pixels, b) eliminate all pixels that can not represent a face, c) segment all the regions containing facelike pixels using region growing, d) eliminate regions which can not represent a face using heuristic rules.

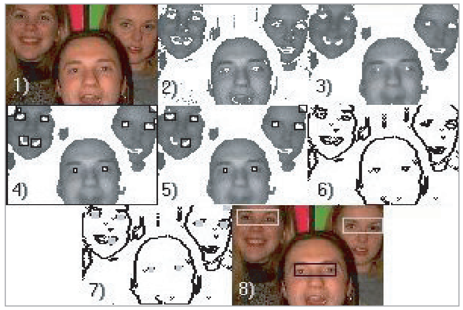


Figure 2: Basic steps of our face detection method [17]: 1) input image, 2) all non-skin colors are eliminated, 3) image filtered with median filter, 4) segmented white regions, 5) eliminated insignificant white regions, 6) traced edges, 7) circles within candidate face regions indicating possible eye positions, 8) output image with confirmed faces.

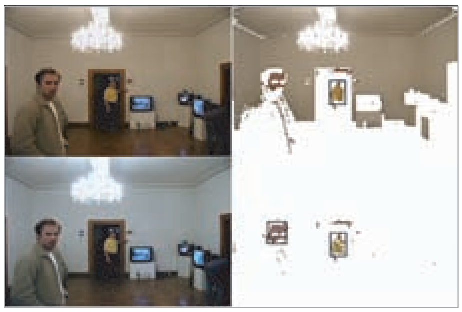


Figure 3: GW performance: the upper part of the figure shows how face detector failed to detect faces due to confusion caused by surrounding colors. This was improved by GW preprocessing as seen in the lower part of the picture. The image was chosen from the incandescent subset of images.

Figure 4: Retinex performance: In the upper part of the figure we see two false detections, while on the lower part this problem was overcome by the Retinex algorithm. The image was taken from the flashlight subset.

Method	None	GW	MGW	RET	None	GW	MGW	RET
Illuminant	**standard**				**incandescent**			
All Faces	109				95			
Detected	75	70	65	76	45	57	42	43
TP	68	65	60	68	28	45	31	29
FP	7	5	5	8	17	12	11	14
FN	40	44	48	40	67	50	64	66
TP/Det	90,66	92,85	92,31	89,47	62,22	78,95	73,81	67,44
FN/All	36,70	40,37	44,04	36,70	70,53	52,63	67,37	69,47
Illuminant	**flashlight**				**neon**			
All Faces	112				78			
Detected	55	47	43	39	63	64	29	60
TP	38	39	36	32	50	54	26	49
FP	17	8	7	7	13	10	3	11
FN	74	73	76	79	28	24	52	29
TP/Det	69,09	82,98	83,72	82,05	77,77	84,37	89,66	81,66
FN/All	66,07	65,18	67,86	70,53	35,90	30,77	66,66	37,18

Table 1: Color compensation results show the number of all detections (Detected), the number of detected faces as true positives (TP), number of false detections as false positives (FP) and number of faces missed as false negatives (FN) on four subsets of images which represent different illumination conditions (standard, incandescent, flashlight and neon), previously preprocessed by Grey World (GW), Modified GW (MGW), White Patch Retinex (RET) or no preprocessing at all (None). Row All Faces shows the number of faces in particular subset of images. TP/Det shows the percentage of true positives out of all detections and FN/All shows the percentage of false negatives out of all faces in the subset. For the installation the first percentage is extremely important, while the second one is merely informative, since we have consciously eliminated faces that were too small for further processing but were included in the number of all faces! Note that TP + FN ? All, since the region characterized as TP can contain one or more faces but counts as only one TP.

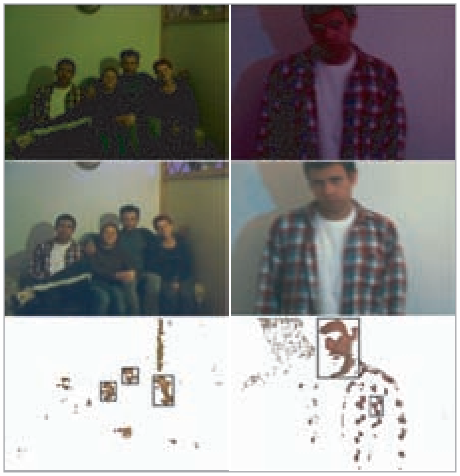


Figure 6: Correlation performance on images from the green (left) and blue (right) subset. On the original image (top) no faces could be detected. After corrected illumination (middle) three faces could be detected on the left image.

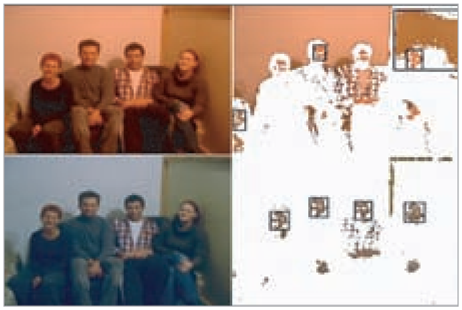


Figure 5: Correlation performance on image from the yellow subset: detection results on image without preprocessing (top) and after illumination reconstruction (bottom).

Illuminant	*white*	*yellow*		*green*		*blue*		*red*	
Method	**None**	**None**	**C**	**None**	**C**	**None**	**C**	**None**	**C**
All Faces	38	35		23		42		34	
Detected	43	13	40	0	18	19	80	10	25
TP	35	7	34	0	13	0	29	0	23
FP	8	6	6	0	5	19	51	10	2
FN	2	28	1	23	10	42	13	34	11
TP/Det	81,39	53,85	85,00	0	72,22	0	36,25	0	92,00
FN/All	5,26	80,00	2,86	100,00	43,48	100,00	30,95	100,00	32,35

Table 2: Correlation results show the number of all detections (Detected), number of correct face detections as true positives (TP), number of detections that turned out not to be faces as false positives (FP) and the number of faces missed by detection algorithm as false negatives (FN) for different subsets of images (white, yellow, green, blue and red), previously processed by correlation algorithm (C) and with no preprocessing at all (None). Row All Faces shows the number of faces in a particular subset of images. TP/Det shows the percentage of true positives out of all detections and FN/All shows the percentage of false negatives out of all faces in the subset. The TP/Det is for the installation extremely important, while FN/All is merely informative for the performance of our face detector. Small faces are deliberately eliminated from further processing already by the face detection algorithm. Note that TP + FN ? All, since the region characterized as TP can contain one or more faces but counts as only one TP.

Računalniški vid v novomedijski umetniški produkciji

Slike in video igrata osrednjo vlogo v novomedijski produkciji. Video kamero v kombinaciji z različnimi vrstami naprav za prikazovanje vizualnih informacij so uporabljali že številni umetniki, pogosto kot neke vrste elektronskega ogledala za zajem in prikaz interakcij z obiskovalci galerij. Zaradi skokovitega napredka računalniške tehnologije so slike in video v vedno večji meri v digitalni obliki. Digitalna oblika pa hkrati pomeni ne le boljšo slikovno kvaliteto temveč tudi veliko lažjo manipulacijo s posnetim gradivom, bodisi v smislu grafičnih transformacij ali odkrivanja višjenivojskih informacij v slikah. Računalniška grafika je tisto področje računalništva, ki se ukvarja s preoblikovanjem obstoječih ali s kreiranjem povsem novih oblik. Z odkrivanjem informacij v slikah pa se ukvarja računalniški vid.

Računalniški vid z analizo posameznih slik ali njihovega zaporedja (video) lahko odkriva različne vrste informacij o prizoru, ki je prikazan na slikah. Na primer, kateri predmeti in kje so na slikah ter kakšno obliko imajo? Tako je možno tudi identificirati ljudi na osnovi slik njihovega obraza ali ugotoviti, kaj delajo. Računalniški vid se je v preteklosti uporabljal predvsem v vojaške, industrijske in medicinske namene. Kljub hitremu napredku pri razvoju metod in algoritmov se računalniški vid še ne more primerjati s sposobnostmi človeškega vida. Zaradi cenovno vse bolj dostopne opreme in zmogljivejših računalnikov pa se uporaba računalniškega vida širi na druga področja, med drugim tudi na področje umetnosti. Obe moji interaktivni instalaciji, "15 sekund slave" in "Virtualno smučanje" temeljita na uporabi računalniškega vida.

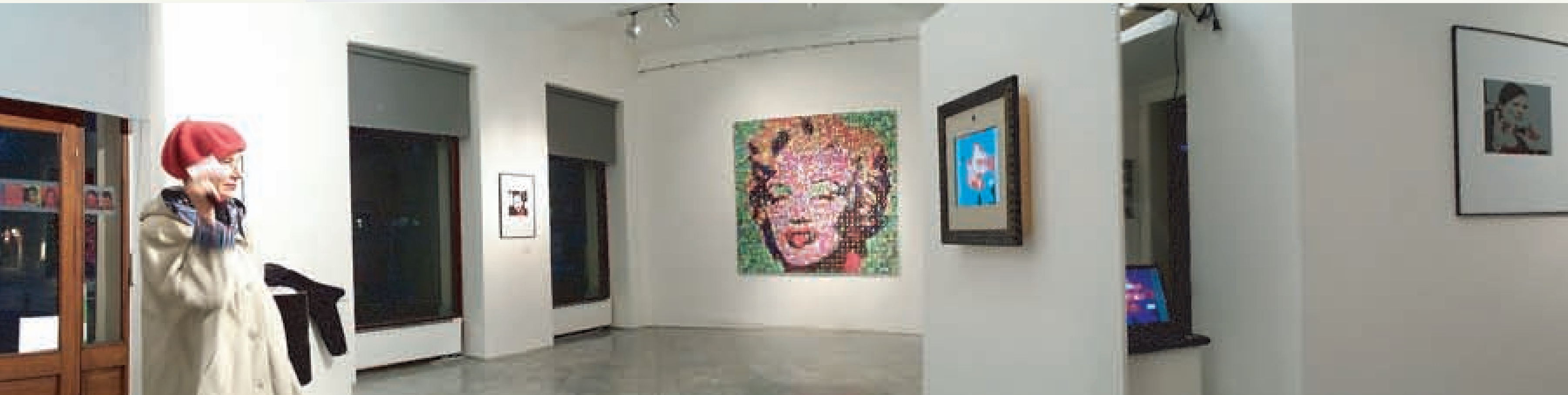
"15 sekund slave" je interaktivna instalacija, ki obraz naključno izbranega obiskovalca galerije predela v "umetniški portret". Instalacijo je navdihnil Warholov citat o slavi, da bo v prihodnosti vsakdo lahko slaven vsaj 15 minut, in njegovi portreti slavnih ljudi v popart stilu. Vidni del instalacije predstavlja ploski računalniški monitor, ki je okvirjen kot slika. V ozadju pa instalacijo sestavlja še računalnik, digitalni fotoaparat in programska oprema, ki detektira obraze na slikah in jih grafično preoblikuje. Digitalni fotoaparat, ki je skrit v okvirju slike nad monitorjem, vsakih 15 sekund slika ljudi, ki stojijo pred instalacijo. Na teh slikah nato računalnik detektira človeške obraze, naključno izbere enega od njih, izbrani obraz nato izreže iz slike in ga preoblikuje v popart stilu. Tako nastali portret se na koncu prikaže za 15 sekund na sliki/monitorju. Naloga računalniškega vida v tej instalaciji je predvsem detekcija človeških obrazov. Detekcija obrazov in njihova kasnejša identifikacija je danes zelo aktualen raziskovalni problem, saj je vedno več video nadzornih sistemov, ki jih želimo avtomatizirati. V našem primeru detekcijo obrazov rešujemo na osnovi barve človeške kože. Postopek lahko razdelimo na tri osnovne korake: (1) izločanje slikovnih pik, ki ležijo v barvnem intervalu, ki ustreza koži, (2) združevanje izbranih sosednjih slikovnih pik v regije, in (3) na osnovi hevrističnih pravil izločanje tistih regij, ki ne morejo ustrezati obrazu, zaradi napačnih dimenzij ali premajhnega odstotka kožnih slikovnih pik v pravokotnem oknu, ki obkroža regijo. Metoda je občutljiva na tip osvetlitve scene, zato je pri umetni svetlobi potrebna še kompenzacija osvetlitve. Računalnik nato še naključno izbere enega od detektiranih obrazov, ga s pomočjo grafičnih filtrov predela v popart portret in ga 15 sekund prikazuje. Prikazane portrete je možno naročiti po elektronski pošti tako, da se na ustrezen elektronski naslov pošlje identifikacijsko številko, ki spremlja vsake portret. Tehnične podrobnosti detekcije obrazov, barvnih transformacij v popart slogu in naročanja portretov po elektronski pošti so opisane drugje.

Poiskati najbolj primeren način interakcije z virtualnimi svetovi ostaja pereč problem nasploh in še posebej v umetnosti, saj se veliko novomedijskih umetnikov izraža prav s konstruiranjem svojih virtualnih svetov. Običajno smo ljudje kot uporabniki virtualnih modelov pri njihovi uporabi omejeni na tipkovnico in računalniško miško. Izkušnje pa kažejo, da je najbolj naravna interakcija z virtualnim svetom, če lahko uporabimo kar naše celotno telo in ponavljamo oziroma uprizarjamo gibe, ki bi jih delali pri isti aktivnosti v fizičnem svetu. V instalaciji "Virtualno smučanje" zato lahko enostavno z nagibanjem telesa oziroma prenašanjem teže na levo ali desno smučko vijugamo, s prehajanjem v nizko prežo pa pospešimo svoje gibanje skozi virtualno zimsko pokrajino. To interakcijo omogoča računalniški vid, ki zaporedje slik iz video kamere, ki snema smučarja, sproti analizira in izračunava trenutni položaj smučarjevega telesa. Računalnik na slikah detektira smučarjevo silhueto in jo loči od ozadja ter nato izračuna položaj njenega težišča. Premik težišča v levo ali desno pomeni, da smučar v virtualnem svetu zavija levo oziroma desno. Smučarjeva nižja preža pa pomeni manjši zračni upor in zato večjo hitrost drsenja po virtualnem snegu. Teren po katerem smuča je posejan z drevesi, ki se jim mora z vijuganjem izogibati. Virtualno zimsko pokrajino opazuje projicirano na steni pred seboj. Projicirana slika naj zajame čimvečji zorni kot, da se smučar lažje potopi v virtualni model. Zato smo tla pred in okoli smučarja tudi potresli z umetnim snegom.

Obe instalaciji sta nastali v okviru gibanja in kasneje ustanovljenega društva ArtNetLab, ki pospešuje uporabo informacijskih tehnologij v umetnosti in ki je omogočilo sodelovanje študentov in pedagogov Akademije za likovno umetnost ter Fakultete za računalništvo in informatiko z Univerze v Ljubljani. Pri programiranju in tudi konceptualnih izboljšavah obeh instalacij so sodelovali naslednji člani Laboratorija za računalniški vid: Borut Batagelj, Peter Peer, Samo Juvan in Slavko Glamočanin.

dr. Franc Solina

Galerija spomeniškovarstvenega centra,
Ljubljana, 17. - 21. 11. 2003



Laboratorij za računalniški vid
Fakulteta za računalništvo in informatiko
Univerza v Ljubljani

Computer Vision Laboratory
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Programiranje / Programming:
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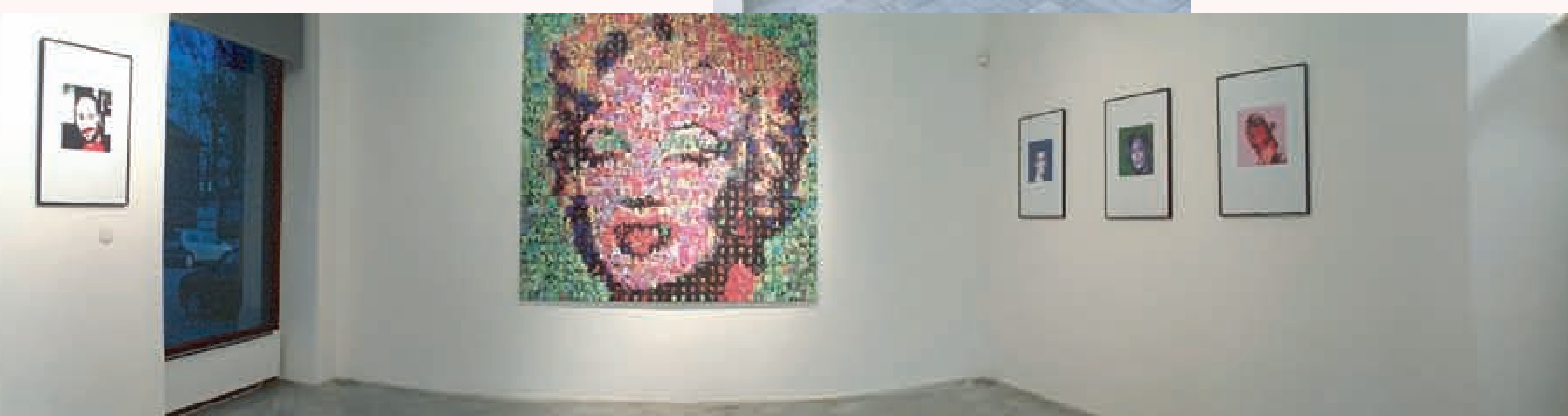
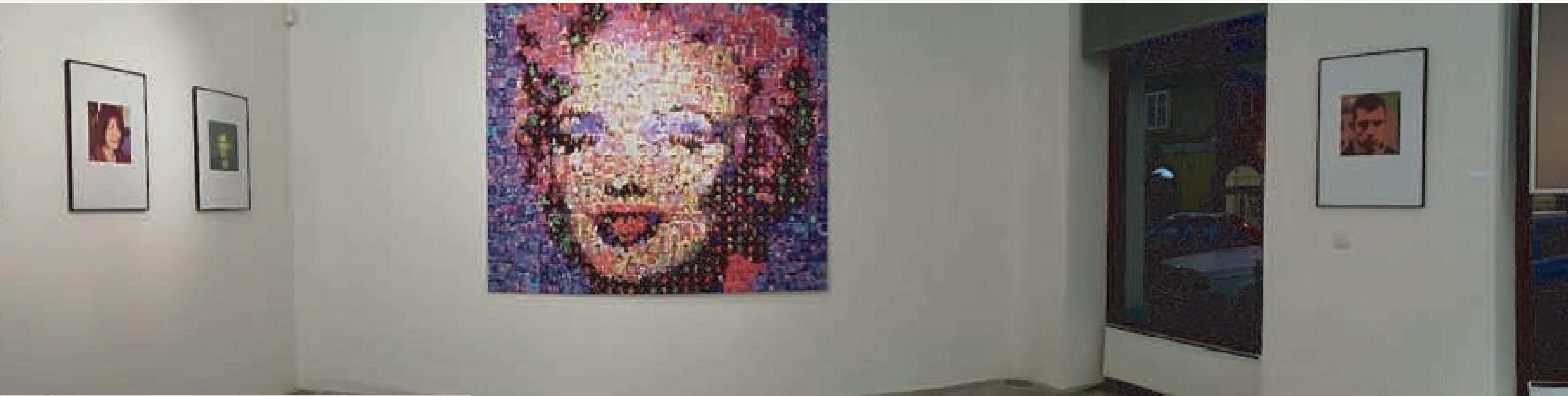
Borut Batagelj,
Samo Juvan



http://black.fri.uni-lj.si/15sec/

15 sekund slave je interaktivna umetniška instalacija, ki obraz naključno izbranega obiskovalca galerije povzdigne v umetniški objekt za 15 sekund. Instalacija je bila navdahnjena s slavnim citatom Andyja Warhola: "V prihodnosti bodo vsi ljudje doživeli svojih petnajst minut slave" kot tudi z njegovim načinom predelave obrazov v slogu popart. Instalacija je sestavljena iz računalnika z zaslonom LCD, ki je uokvirjen in razstavljen kot dragocena slika na steni, digitalnega fotoaparata, usmerjenega v ljudi pred zaslonom in posebej izdelane programske opreme, ki na slikah poišče človeške obraze in jih grafično predela.



15 seconds of fame is an interactive art installation which elevates the face of a randomly selected gallery visitor for 15 seconds into a "work of art". The installation was inspired by Andy Warhol's statement: "In the future everybody will be famous for fifteen minutes."and by the pop-art style of his works. The installation consists of a computer with a framed flat-panel monitor, a digital camera and proprietary software that can detect human faces in images and graphically transform them.

15 sekund slave / 15 seconds of fame

Virtualno smučanje / Virtual Skiing

Interaktivna instalacija "Virtualno smučanje" omogoča podoživljanje občutkov drsenja po snegu skozi zimsko pokrajino. Zimsko pokrajino, ki je ustvarjena s pomočjo računalniške grafike, udeleženec opazuje pred seboj na celotni steni. Kot na pravih smučeh lahko hitrost spuščanja uravnavamo s spreminjanjem drže našega telesa, tako da večamo ali manjšamo svoj zračni upor. S prenašanjem teže na levo ali desno smučko pa lahko še vijugamo med zasneženimi smrekami po bregu navzdol. Za uravnavanje gibanja skozi virtualni svet skrbi tehnologija računalniškega vida, ki beleži položaj smučarjevega telesa.

Galerija Spomeniškovarstvenega centra., Ljubljana, 1. - 12. 2. 2005.

The interactive installation "Virtual skiing" enables a visual immersion into the feelings of gliding on snow through a winter landscape. The computer rendered winter landscape is displayed over the entire wall in front of the skier. As on real skis you can regulate the speed of descent by changing the posture of your body so that the air resistance is decreased or increased. By shifting the weight of your body to the right or left ski you can make turns down the slope between the snow capped trees. The interface to the virtual world is implemented by computer vision techniques, which capture the posture of the skier's body.

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http://black.fri.uni-lj.si/ski/

Ideja/Idea: **Franc Solina**

Programiranje/Programming:
Slavko Glamočanin,
Borut Batagelj.

Razstava je del produkcije ArtNetLaba, ob podpori Ministrstva za kulturo Republike Slovenije, Ministrstva za visoko šolstvo, znanost in tehnologijo, Mestne občine Ljubljana ter Laboratorija za računalniški vid Fakultete za računalništvo in informatiko Univerze v Ljubljani./The exhibition was produced by ArtNetLab and sponsored by Ministry of Culture, Ministry of Higher Education, Science and Technology, Municipality of Ljubljana and Computer Vision Laboratory, Faculty for Computer and Information Science, University of Ljubljana.

Zahvaljujem se prof. Sreču Draganu z Akademije za likovno umetnost, ki me je leta 1996 povabil k sodelovanju pri realizaciji svojih projektov in mi tako postopoma odkrival tudi umetniško plat novih medijev. Skupaj sva nato omogočila še podobno, na realizaciji umetniških projektov zasnovano, sodelovanje najinim študentom računalništva in umetnosti. Vsa ta aktivnost me je vzpodbudila, da sem v okviru sodelovanja, ki smo ga poimenovali ArtNetLab, poskusil tudi z lastnimi avtorskimi projekti. Tako sta se rodila projekta "15 sekund slave" in "Virtualno smučanje". Pri realizaciji teh dveh projektov so mi pomagali predvsem moji študentje Borut Batagelj, Peter Peer, Slavko Glamočanin in Samo Juvan iz Laboratorija za računalniški vid na Fakulteti za računalništvo in informatiko. Pri postavitvah instalacij in oblikovanju raznovrstnih gradiv pa so dali na voljo svoje dragoceno znanje Dušan Bučar, Narvika Bovcon in Aleš Vaupotič z Akademije za likovno umetnost, za kar se jim toplo zahvaljujem. Nazadnje se zahvaljujem za potrpljenje in vzpodbudo tudi svoji družin, Andreji, Nataši in Emi Lori.
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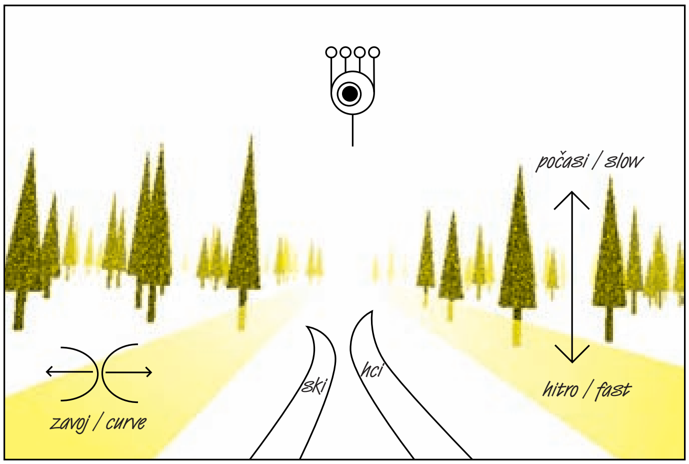
ArtNetLab
Društvo za povezovanje umetnosti in znanosti



Razvoj tehnologij, predvsem računalniških, je v zadnjih treh desetletjih prinesel spreobračanje družbenih odnosov ter pospešil tempo družbenih dogajanj. Likovna umetnost je s tem pridobila nove možnosti izražanja in vključevanja v družbena ali druga (npr. politična) angažiranja. Tehnoumetnost je postala velik izziv za umetnike pa tudi za teoretike, ki odkrivajo premike na področju interaktivnosti in moderne ustvarjalnosti.
The evolution of technologies, above all computer technologies brought to a turning point all social relations and accelerated the pace of all social interactions. Art earned new means of expression and became engaged in social, political and other events. Techno-art became a major challenge for artists and theorists uncovering movements in the field of interactivity and modern creativeness.

mag. Dušan Bučar, ArtNetLab

Virtualno smučanje / Virtual Skiing

Franc Solina: 15 sekund slave in Virtualno smučanje/
15 Seconds of Fame and Virtual Skiing.
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